NO. 24.

THE
Sidereal Messenger.

Conducted by Wm. W. PAYNE,
Director of Carleton College Observatory.

MAY, 1884.

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"He telleth the number of the stars; He calleth them all by their names.'

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XUM

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The Sidereal Messenger.

Conducted by Wm. W. PAYNE, Director of Carleton College Observatory, Northfield, Minn.

"In the present small treatise I set forth some matters of interest to all observers of natural phenomena to look at and consider."—GALILEO, *Sidereus Nuncius*, 1610.

VOL. 3. NO. 4. MAY, 1884. WHOLE NO. 24.

THE GREAT COMET OF SEPTEMBER, 1882.

PROFESSOR H. A. HOWE, DENVER UNIVERSITY.

This great comet has fled from the gaze of man, and thirty generations of astronomers will pass away, before it will submit itself to human scrutiny. Then, perchance, it will again burst unexpectedly into view, to be firmly bound by the chains of mathematical analysis, which, though more tenuous than gossamer, are stronger than steel. As a man's biography comes suitably after his death, but before the remembrance of him has faded from men's minds, so, since this comet is now buried in the darkness of space, a short history of it, with a fresh prediction of the time of its resurrection, may not be inappropriate.

The first accurate observation of which we have record was made by Mr. FINLAY at the Cape of Good Hope, on Sept. 7, ten days before perihelion passage. Just before it reached its perihelion the same observer watched its disappearance among the undulations of the *Sun's* limb, as it began its transit, describing an apparent path not dissimilar to that of *Venus* on Dec. 8, 1874, though opposite in direction. Its velocity was nearly 300 miles per second, and it

dashed through the outer envelope of the *Sun* at a distance of 280,000 miles from his surface, being thus exposed to a heat so intense, that one is reminded of the old speculation that comets are the enforced abodes of lost spirits, which are thus exposed to uncomfortable extremes of temperature. Its nucleus then appeared as a fiery globular mass, whose diameter was about 2,000 miles. Prof. PETERS observed five or six envelopes rising sunward to a height of 12,000 miles above the straw-colored nucleus, while opposite the *Sun* extended a brush 38,000 miles long. In a few days the nucleus appeared elongated, and soon seemed to split into a number of parts, or, more exactly, a number of centers of condensation were formed, ranged in a right line, connected by, and enveloped in, the coma. As the weeks went by these centers changed their appearance and relative positions, and gradually became fainter till June, 1883 when the comet was observed for the last time, at Cordoba.

'Its spectrum, which was so brilliant that it was studied in the day-time, was chiefly characterized by the presence of the bright lines of sodium; a narrow, continuous spectrum given by the nucleus was clearly seen. Hence we conclude that its density was considerable, and that a collision between such a body and the earth, would be fraught with disastrous results to us.

It now remains to collect all the observations and compute the orbit as accurately as possible. Here a formidable difficulty arises. Since the comet approached very near the *Sun*, the intense heat caused a violent action in the nucleus; as the fluid matter rose toward the *Sun*, and was again repelled, it seems that certain quite dense portions of the nucleus were carried off. After perihelion, a cooling process set in, and the denser portions drew the surrounding fluid matter to themselves; thus the various condensations were formed. Now, different observers observed different portions of the head; some took the positions of the fainter points of light, because they were more star-like, and thus their positions could be more accurately determined; others

very naturally observed the brighter portions. When the object became faint the centre of the elongated, nebulous mass was taken. Observations of the relative positions of the centres of condensation were made by few, the best series being at Athens, Cape of Good Hope and Mt. Lookout.

First, then, by a careful discussion, all the observed right ascensions and declinations should be reduced (as far as possible) to some point which is thought to be the centre of gravity. If this point can be found, and the observations referred to it, its motion ought to satisfy elliptical elements very well, since the disturbing forces are apparently slight.

Five forces acted upon the nucleus, viz.: the *Sun's* attraction, the attraction of the planets, the mysterious force which drove away the comet's tail, the resistance of the corona, and the forces within the nucleus, caused by the intense heat. Dr. MORRISON has remarked that the perturbations produced by the planets were absolutely inappreciable; so narrow was the ellipse that the repulsive force from the *Sun* would tend to diminish the velocity before perihelion, and increase it afterwards; but this force is small. The observations have not shown any effect of the resistance of the corona; the disruptive forces within the nucleus have no power to change the position of the centre of gravity in space, for the centre of gravity in a moving system is unaffected by the mutual actions of internal forces. Nor would the diminution of the mass of the body, as a portion of it was driven away along the tail, affect its path. Hence the determination of the position of the centre of gravity with reference to the points of condensation is a task to which the computer should address himself.

Since all the drawings and discussions of the nucleus have not yet been printed, the writer has made an approximation to the true orbit, by the aid of the observations made at Cordoba. The same point in the nucleus was observed until Feb. 12, 1883; after that date the point was in-

visible, and the centre of the elongated nebulous mass was taken. The observations were compared with an ephemeris computed from Prof. FRISBY's elements. The normal places were as follows:—

Greenwich M. T. Equinox of 1883.0

	Nov. 16.0, 1882.			Jan. 3.0, 1883.			Mar. 25.0, 1883.		
α	141°	55′	46.″43	106°	53′	58.″08	88°	22′	36.″47
δ	−24	50	4. 77	−29	7	17. 79	−10	46	17. 33
λ	154	8	47. 75	113	53	55. 04	88	4	17. 62
β	−37	26	50. 85	−51	10	56. 64	−34	12	54. 16
L	234	4	19. 30	282	49	42. 60	4	30	19. 90
log R	9.9949425			9.9926772			9.9990495		

Using the notation in the new edition of Oppolzer, Vol. I, the following values of constants were obtained:—

	Prime.			Third.		
P	217°	52′	41.″17	325°	36′	59.″16
ϕ	82	1	1. 32	84	40	59. 11
log N	9.1375780			8.9659629		
log D	9.9907133			9.9971768		

W	290°	27′	35.″07	log	f′	9.5578575
W′	207	6	34. 86	"	A′	8.7397621
H	6	23	25. 88	"	B′	9.3577802
H′	7	43	24. 78	"	C′	9.4872718n
F′	38	3	56. 66	"	K	0.1494578
G′	297	4	50. 33	" tan	J	1.3113119

From Prof. FRISBY's orbit the following six quantities were obtained:

2 f‴	1°	24′	24.″64	log	r‴	0.5559818
2 f″	2	30	39. 22	"	r″	0.3938543
2 f′	1	6	14. 58	"	r′	0.2229559

By the aid of these the following were computed:—

I	1.5785324	log VII	0.3537552
log II	1.0683348n	log VIII	0.5789603n
log III	0.1505931n	log IX	1.0167042
IV	0.2465647		
log V	0.5210239n	log Γ	9.7916529n
log VI	1.1807771n	log Δ	0.0054556n

In the approximations for distance, the following values of the principal quantities were found:—

	1st Approximation.	4th Approximation.
log x	7.8349975	7.8352897
log y	9.5630839	9.5632102
log ρ'	0.1733953	0.1733778
log ρ'''	0.5501693	0.5501474
log r	0.2227984	0.2227857
log r‴	0.5559388	0.5559181

With these improved values, a new computation of the

quantities I, A etc. (which depended upon Prof. FRISBY'S orbit, and were used in the approximations for distance), was made. Then new approximations for distance were made. The heliocentric longitude and latitude were then found. The final results were:—

		Prime.	Second.	Third.
log	r	0.2227856	0.3937567	0.5559179
log	ρ	0.1733776		0.5501472
2	f	1° 5′ 38.″239	2° 29′ 17.″746	1° 23′ 39.″509
	l	110 13 32. 22		107 25 22. 45
	b	—32 51 51. 13		—33 42 8. 42
	u	241 35 46. 56		244 5 4. 33

The system of elements thus became:—

T	Sept. 17.2637,	Gr. M. T., 1882.	
π	55° 2′	16.″59	1883.0
Ω	345	43 55. 01	
i	141	54 31. 54	
φ	89	13 55. 8	
	log e	9.9999610	
	log q	7.8821773	
	log a	1.9289	
		Period 782.4 years.	

The second normal place was satisfied within 0.″02 in both lognitude and latitude. The perihelion distance is 707,500 miles, the semi-major axis 7,878,000,000 miles, and the semi-minor axis 105,600,000 miles.

If this be the comet which appeared in 370 B. C., whose orbit was calculated by PINGRE from Greek observations, its mean period during three revolutions has been 751 years. The comet of 370 B. C. had a very small perihelion distance, and was otherwise similar to that of 1882. In the year 1131 A. D., a comet was seen, and in 1132, two of them came into view, according to the Chinese chronicler MATUOANLIN, but their orbits are unknown.

THE PLANET SATURN.

BY THE EDITOR.

The time for best observations on the planet *Saturn* has passed for this year; and as the noble object takes its leave of us, it may be profitable to state briefly the important and

interesting results of recent physical study upon its wonderful system that have come to our notice. Telescopes in all parts of the world have been vieing with each other in careful scrutiny of details of that which may be seen under favorable circumstances, and the patient and scholarly search has not been in vain. It will be remembered that the mean distance of the planet is about 882 millions of miles from the *Sun*; its diameter nearly 70,500 miles, and its time of rotation on its axis is $10^h\ 14^m\ 24^s$, less than half of one of our days. Nearly in the plane of its equator, the planet is surrounded by two rings at a considerable distance away, and outside of these revolve eight satellites, which is double the greatest number known to belong to any other planet. Observation is most favorable near the time of opposition, which last occurred Nov. 28, 1883. The next will take place Dec. 11, 1884, and generally these periods succeed one another at intervals of one year and from twelve to fourteen days.

In the telescope the physical appearance of *Saturn* resembles that of *Jupiter*. Upon its surface are seen spots, and light and dark belts lying parallel to the direction in which it revolves. By observing spots the time of the rotation of the ball is determined. The value given approximately above was determined by Professor HALL after a month's study of the transits of a bright spot across the central meridian, and is about two minutes less than that found by Sir WILLIAM HERSCHEL eighty-two years earlier. The motion of a point, then, on the equator of *Saturn* would be nearly six miles per second. The globe is not a sphere, but its figure is that of an oblate spheroid, and strange to say, its polar compression is greater than that of any other planet, not excepting *Jupiter*, which is larger, and also rotates in less time than *Saturn*. The polar diameter is less than the equatorial by about 7.800 miles. Its axis of rotation is inclined 64° 18′, the equator making an angle with the same plane of 25° 42′. *Saturn*, therefore, has greater extremes of temperature during its year than *Earth* or *Mars*.

No one knows anything of the internal condition of *Saturn*, and that of the surface is little more than conjecture. What is seen is thought to be a dense layer of vapors and cloud-like forms, through which the eye cannot penetrate with the strongest optical aid; and yet it is quite evident that the parallel bands, as in the case of *Jupiter*, are due to the rapid rotation of the planet on its axis. The bands are fainter than those of *Jupiter*, and spots are of rare occurrence.

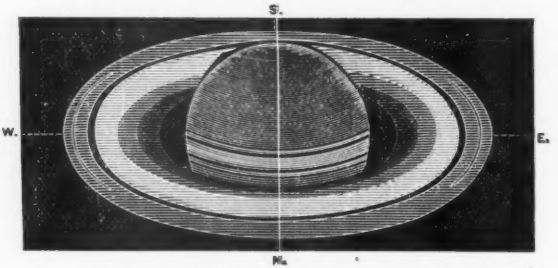
The chief characteristic that distinguishes the Saturnian system from every other celestial object, is the broad, flat ring that encircles the equator at a considerable distance from it. By increase of telescopic power, the single ring is easily divided, and the two stand out concentrically over the equator, the inner one being the brighter of the two, with a broad, dusky edge toward the planet. This rapid shading off of the inner edge of the bright ring has been spoken of, unfortunately, as a separate one, and called the Crape Ring; but is difficult to see why it should be thought of as a separate ring when there is nothing to indicate it.

It is now well established that these rings do not form a continuous mass, either of solid matter, as early supposed, or of fluid substance, as later believed; but that they are really streams of minute meteoric bodies, countless in number, yet all independent, and revolving in separate orbits about the planet. They are so many, and so far away from the *Earth*, that they appear as a continuous mass, "like particles of dust floating in a sunbeam," as elegantly penned by one writer.

This very brief and imperfect statement of what is known and on record will refresh the mind of the reader, and that which follows will appear as new in its proper relation.

Careful English observers have given attention to the belts and rings of *Saturn* during the last opposition. Mr. RANYARD, in November last, noticed a narrow, dark belt stretching across the disc of the planet, and slightly fading away towards either limb. It was as easily seen as Cassini's

division on the ring. At the January meeting of the Royal Astronomical Society Mr. GREEN (February *Observatory*) made a sketch on the blackboard to indicate the relative positions of the different belts on *Saturn*. Mr. GREEN said that the ring hid the northern part of the planet, but the outline of the ball could be traced on either side for some distance through ring C—the dusky ring. To the south of the dusky ring was a bright belt, the central position of which was so brilliant as almost to suggest that Mr. BRETT's hypothesis of specular reflection might be applicable to it. Further to the south there was a dark, broad belt, which he thought was the one Mr. PRATT had described as the Vandyke-brown belt, which he should be more inclined to speak of as a sepia belt. In contact with this was a narrow belt, which he believed was the one Mr. RANYARD had described. It had the looped edges referred to, and was not a clean, even belt. The color of the dark belts seemed to him of a rich, yellowish brown, something of the tint seen on a Cochin-China egg. Further to the south was another belt, and, finally, there was a faint, ill-defined cap round the southern pole." Mr. GREEN claimed that there had been great changes on the planet's surface during the last year.



American astronomers have also observed this new narrow belt. Professor E. S. HOLDEN's note-book, Nov. 8, '83, contains the following, which has also appeared in *Observatory* for March, with a drawing, which is reproduced above.

"*The Ball.* The S. hemisphere is dark; the S. pole the

darkest. A dark stripe along the S. edge of the bright equatorial belt. The belt has a dark and narrow stripe along its middle. Dec. 2 (accompanying drawing), the S. pole is mottled, especially so near the shadows. The bright equatorial belt is bounded on the S. by a narrow, dark belt some 2″ wide; it is the darkest thing on the ball. South of this is an equally narrow, bright streak; then S. of this is the nearly uniform S. hemisphere. N. of the equatorial bright belt is a narrow, dusky belt (1.″5?), then a narrow, bright belt (1.″5?), and then the dark band, which is the dusky ring itself (C). The principal division is seen all around; that in ring A. is seen at both ends. The shadow of the ball on the ring is as drawn. It is wider and of different shape on the preceding side, as drawn. I did not specially look for (or see) the shadow of the ball on the ring C."

Professor C. A. Young, with the 23-inch Clark equatorial of the Halsted observatory, in Nov. last saw the ball of *Saturn* through Cassini's division. Professor HALL of Washington was present at the time, and shared in the interest of this rare observation. Professor YOUNG says the "seeing was very fine at the time. *Mimas* was conspicuous not far from conjunction, and so was the olive-green polar cap, and the brownish and reddish belt south of the white equatorial belt." These observers saw Cassini's division perceptibly less dark where the ball of the planet was behind it. So far as we know, this is the first time that the planet has been noticed through the dark space between the rings. The observations of Professor GEORGE DAVIDSON, U. S. Coast Survey, San Francisco, in the astronomical notes of Bulletin 1 of the California Academy of Sciences, are exactly in the line of our thought. They are so well stated that we give them in full. Under the head of *Saturn*, he says:—

"*The position of the Encke division* plainly divides the outer ring A into two slightly unequal annuli by being nearer the outer than the inner circumference. This was

certainly the case at the preceding part of the ring, but at the following part of the ring the division was apparently nearer the inner circumference. This anomaly was doubtless occasioned by the sun shining full on the preceding part of the ring, but at the following part the shadow of the raised rim of the outer circumference of the B ring was projected across and beyond the outer edge of the Encke division upon the inner bright border of the A ring. This reduced the apparent breadth of the inner annulus of the A ring at that point, and makes it appear narrower than the outer annulus. When the atmosphere was quiet this shadow made the breadth of the Encke division greater at the following than at the preceding part of the ring. It was, of course, a very small difference, yet it was unmistakable, under favorable conditions. *The dusky ring.* While there were but two or three occasions on which the inner circumference of the dusky ring was sharply defined, yet without this condition, there were no times when the extreme parts of the dusky ring were equally distinct. And upon most occasions the preceding part of the ring was the brighter. It became a question why this appearance was so generally presented; whether it was in the ring itself, and would thus give a clue to its period of rotation, or whether it was owing to the direction of the atmospheric waves of disturbance as we see them in geodetic observations, whether due to peculiarities of the telescope or the observer's eye. Sometimes these observers made the comparison before announcing the result; the atmospheric disturbance might account for part of it. Changes of eye-pieces did not correct the impression. Decided change of parts was exhibited during one period of two or three hours. But upon more than one occasion the following part has seemed the brighter without any doubt in the observer's mind. It seems that one reason for the preceding part being brighter than its normal tone, must be in the additional light reflected upon it from the illuminated body of the planet being brighter near the preceding limb, after opposition. I have not had

an evening when the atmosphere continued sufficiently and uniformly quiet to observe during the whole night under equal conditions.

The dusky ring, where it crosses the body of the planet, does not present a uniform tone of color, but the inner circumference seems a little denser and darker than further out. This might arise from a narrow, dark belt on the body of the planet, just on the line of projection of the inner circumference on the body of the planet. There is, across the white equatorial band on the body of the planet, a very narrow, dark belt, which I first noticed close to the edge of the dusky ring. This belt moved very slowly towards the south during December and January.

I have recorded also, upon two occasions, a narrow, dark line across the body of the planet in the dark part south of the bright equatorial belt. It revealed itself only upon short occasions of extreme quietness of the atmosphere.

For all these studies I have used eye-pieces of various characters, with magnifying powers from 120 to 500 diameters, but only on one or two occasions utilizing the latter."

ON THE DEFLECTION OF THE LEVEL DUE TO SOLAR AND LUNAR ATTRACTION*.

BY J. HAGEN S. J. COLLEGE OF THE SACRED HEART, PRAIRIE DU CHIEN, WIS.

(*Continued from page 79.*)

The attraction γ of the disturbing body is:

$$\gamma = \gamma_0 : [1 - \frac{2\rho}{r}\cos z + (\frac{\rho}{r})^2]$$

where γ_0 is the attraction on the center of the earth. The square of $\rho : r$, being less than 0.0003, even in the case of the moon may be omitted, and by the same approximation we may put $\gamma_0 = \theta^2 e$, whence:

$$\gamma = \theta^2 e(1 + 2\frac{\rho}{r}\cos z).$$

*A. N. No. 2568.

Besides we have:

$$\cos(z'-z)=1, \quad \sin(z'-z)=\frac{\rho}{r}\sin z,$$

consequently:

$$\sin z'=\sin(z+z'-z)=\sin z+\frac{\rho}{r}\cos z\sin z'.$$

Finally in those terms which contain the factor $e:r$, we are allowed to write $\sin z$ and $\cos z$ instead of $\sin z'$ and $\cos z'$ and thus find shorter:

$$X=\frac{\theta^2\rho}{2}(3\frac{e}{r}+\cos\lambda^2)\sin 2z.$$

As regards Z, we have even for the moon

$$\theta^2\rho:g<0.000005,$$

consequently the square of this quantity may be omitted, and $Z=-g$. Thus we obtain for the total deflection of the level the formulas:

$$(1)\qquad \frac{\mathrm{d}z}{\mathrm{d}x}=\frac{\theta^2\rho}{2g}(3\frac{e}{r}+\cos\lambda^2)\sin 2z$$

$$\frac{\mathrm{d}z}{\mathrm{d}y}=\frac{\theta^2\rho}{2g}\sin 2\lambda\sin z.$$

From this we have to subtract the deflection caused by the supposed rotation of our earth around a central axis perpendicular to the orbit of the disturbing body. If the latitude of a place with regard to this orbit is denoted by β, the centrifugal force is $\theta^2\rho\cos\beta$, and its projection on the horizon (towards the orbit) $=\frac{1}{2}\theta^2\rho\sin 2\beta$, hence the deflection of the level

$$(2)\qquad =\frac{\theta^2\rho}{2g}\sin 2\beta.$$

This is to be resolved parallel to the axes of x and y. Let the points in which the produced lines R and ρ and the axis of the orbit intersect the celestial sphere, be denoted by R, O and A, then in the right-angled triangle of Fig. 2:

$AR=\lambda$, $RO=90^\circ-z$ and $AO=90^\circ-\beta$. From this we obtain the components:

$$\frac{dz}{dx}=\frac{\theta^2\rho}{2g}\cos\lambda^2\sin 2z\,,$$

(3)

$$\frac{dz}{dy}=\frac{\theta^2\rho}{2g}\sin 2\lambda\sin z\,.$$

By subtracting (3) from (1) we have the true deflection of the level:

$$\frac{dz}{dx}=\frac{3}{2}\frac{\theta^2\rho e}{g\ r}\sin 2z;$$

$$\frac{dz}{dy}=0;$$

or, since $\theta^2 e=\frac{m}{r^2}$, $g=\frac{M}{\rho^2}$,

$$\frac{dz}{dx}=\frac{3}{2}\frac{m}{M}\left(\frac{\rho}{r}\right)^3\sin 2z\,,$$

(4)

$$\frac{dz}{dy}=0.$$

We proceed to compare this solution with those mentioned in the beginning. It is at once seen to agree with PETERS' formula, the forces applied in both solutions being the attraction of the disturbing body both on the center and on the surface of the earth, and the gravity at the earth's surface. The same forces have been applied by RAMUS and SANG, whose formulas essentially coincide with PETERS'. All these solutions agree in that the deflection is directed towards the azimuth of the disturbing body and is greatest when the latter is nearest to the earth and at 45 degrees zenith-distance.

ABEL, on the contrary, disregarded the attraction of the earth by the disturbing body, thus supposing the deflection to be caused by the full attraction of *Moon* or *Sun* instead of taking the difference between the former and latter. His

deflection is therefore too large and besides, reaches its maximum at the rising and the setting of the luminary.

Captain STERNECK's formula is marked (8) on page 561 and 563 and is the following: Deflection $= \frac{a\rho}{2e}\sin 2\beta$. Since his $a = \varphi e : g$ in our notation, it is identical with our formula (2), the effect of a supposed monthly rotation of the earth around a central axis perpendicular to the *Moon's* orbit, which is also expressly mentioned on page 555 of his paper. The deflection of the vertical implied in PETERS' formula is not represented in his, because he disregards the variation of the *Moon's* attraction on different points of the *Earth*, as is stated on page 554.

In the short note of the Report of the British Association it is not said how the lunar deflection, which amounts to nearly one half of that given by PETERS, has been calculated.

In conclusion, I may say that the preceding demonstration in not quite so short and direct as that given by PETERS in the *Bulletin de l' Academie Imperiale de St. Petersbourg*, but, it is hoped, will be found to show forth the errors, especially of those authors who have found lunar deflections to the enormous amount of 0.5 and 0.8 seconds of arc.

OBSERVATIONS ON THE PONS-BROOKS' COMET.

W. H. NUMSEN, BALTIMORE.

(*Continued from page 85.*)

The stellar point small, and brighter than the circular nebulosity, and perfectly distinct from it. The circular nebulosity somewhat fainter, but perfectly distinct from the coma, and the coma faint and indefinite, three grades, as it were. I estimate the *diameter* of the circular nebulosity as about 1′, by a rough comparison with the companion of δ Orionis. At 7:20 moon was out of clouds in east, and with p. 25 tail could be traced for $1\frac{1}{4}^\circ$ pretty plain, and per-

haps 1½°, but after that uncertain. Seems perfectly straight.

Upon comparing my sketch and notes with the drawings in the March number of the MESSENGER, I find it agrees pretty well, except that my telescope, being only a 4-inch, did not show the dark spaces on either side of the nucleus. To me it appeared of nearly uniform brightness, its boundaries terminating sharp, without the slightest trace of fading into coma. The stellar nucleus was so distinct that, at first, I thought the comet was passing over some star.

Jan. 17th.—6:30 to 7:50. Pretty clear; no clouds, but seems slightly misty. Tail much easier to naked eye than expected. Pretty plain for 3° or 4° or so, and I think that, when seen sideways, several degrees longer; possibly 6° or 7° total. Through finder tail only evident for 1½°, but getting misty. Tail, I think, is now slightly curved. If it is, convexity is on south side. (Up to this time the tail had always appeared to me perfectly straight.) With p. 25 bright, circular ring, seen last time, cannot be seen tonight. Nucleus a strong condensation, and think I can see at times a small stellar point, said point not in center, but somewhat more to *n. f.* side of condensation. For 1¼° the tail is evident, bright, and broadens. After that it seems to get thinner, and a fainter, narrower portion starts on. Can't be certain of this fainter portion, for more than 2½°, but getting more misty.

Jan. 20th.—6:30 to 7:20. No clouds, though slightly misty look. To naked eye tail not as bright nor as long as when last seen. Through finder, nucleus plain. Tail appears slightly curved towards right. Certain of it for 3° and over by field of view, and fades away. With p. 25, nucleus pretty stellar and evident. No doubt about tail being slightly curved, and spreads. Convexity on south side, and seems to be somewhat more convexity than concavity. Can't be certain of tail for more than 3° or so. Nucleus is distinct by itself, and pretty stellar. No nebulosity around it, except the pretty uniform brightness of head. Can't see or suspect any brighter point in nucleus.

Jan. 21st.—6:40 to 7:30. Very clear, but slight mist towards west. To naked eye tail appears, I think, slightly curved. Through finder, undoubtedly curved, and sweeps downward. Traced clear across field, 3° though not much further. With p. 25, curvature easily noticed. Surely 3°, and possibly $3\frac{1}{4}$° long, but after that uncertain. If anything, south side is better defined, and more clear cut; north side seems blurred. Nucleus strongly condensed, and pretty distinct, but does not appear decidedly stellar. Can't say that I can see any brighter condensation point in nucleus. Comet getting fainter.

Jan. 23d.—6:30 to 7:20. No clouds, but haze 10° or 15° above horizon. With naked eye, tail pretty easy. Dead sure of it for 2°, and pretty certain for 3°, and possibly a little more. Through finder nucleus pretty distinct and strong. Tail plain for $1\frac{1}{2}$°. With p. 25, tail easy for $1\frac{1}{2}$°, or perhaps 2°. Curvature very easy now. Convex edge always more distinct than concave one. Comet getting low and in the mist.

Jan. 25th.—6:20 to 7:15. Clear. Tail pretty plain to naked eye; certainly $2\frac{1}{2}$° to 3° long; points curved towards β Ceti, and spreads. With p. 25, nucleus appears like an infidenite condensation, somewhat brighter towards middle, but can't pick out any stellar point in it. Border fades into coma. Curvature of tail very pronounced; appears to bend like a bow.

Jan. 26th.—6:15 to 7:15. Very clear and beautiful. Still. Tail pretty plain to naked eye for 2° or so, and I suspect at times a faint continuation to about half-way to β Ceti. Curvature about the same as last night. With p. 25 nucleus appears pretty stellar, and with finder there is a star (est. $1\frac{1}{2}$° pos. 340°) of about equal magnitude to nucleus. Tail easy for $1\frac{1}{2}$° can be traced certainly for 2° and possibly more. Both sides somewhat indefinite.

Jan. 29th.—6:15 to 7:10, Very clear and distinct. Crescent moon. Appears to have "fizzled out;" looks nebulous, but am not certain about seeing tail. With p. 25 nucleus

appears at times pretty stellar, though not sharply so. There is a star about 15′ *n. f.*, pos. 45°. Nucleus appears about as large as this star, though not as bright. Pretty sure of tail for 1°, and sometimes think can trace it clear across field 1½°. Still curved, though I think not as much as before. Very indefinite on both sides and towards end.

With reference to the foregoing, I would say that I am conscious of the fact that I may have made errors in the observations, but if I have, I have tried to do so upon the side of seeing too little, rather than too much. The length of tail was estimated by judging from diameter of field. To avoid bias and previous knowledge, it was my custom to make observations, first, with naked eye, then with finder, and then with comet eye-piece, making notes of each, separately, at the time. This rule was generally followed, except when the state of the sky was so uncertain as to cause me to hurry up.

Baltimore, March 17, 1884.

INTRA-MERCURIAL PLANETS.*

The scientific journals bring us items from the reports of M. TROUVELOT, who accompanied Mr. JANNSEN to the Caroline Island in the South Pacific, to observe the total solar eclipse, of May 6, 1882.

The members of this Academy will recollect that JANNSEN and his associates upon their return *via* San Francisco, were invited to attend our meeting. Messrs. PALISA and TACHINI and ROCKWELL were absent. All these gentlemen had been observers of the eclipse, and some of them had specially directed their attention to the question of intra-mercurial planets. No one had seen any sign of these bodies, but M. TROUVELOT made known to the Academy that at the time of totality he had seen a star—a red star—

* A paper read by Professor George Davidson, U. S. Coast Survey, before the California Academy of Sciences, as it appeared in Bulletin No. 1.

of the fourth magnitude, about three degrees north and three degrees west of the *Sun*, and that the star had no definite disk or appreciable phase. He had no opportunity to consult star charts, and therefore he could not pronounce judgment upon its being a star or an intra-mercurial planet.

The next day I placed the *Sun* in its proper position on the star charts of ARGELANDER, and then found δ *Arietis*, of the fourth magnitude, situated two and three-fourths degrees north and two and three-fourths degrees west of the *Sun*. I had to be absent during the day, but M. TROUVELOT came and examined the charts and my location of the *Sun*. This to my mind was the solution of M. TROUVELOT'S red star. But δ *Arietis* is not a red star, and we can only suppose that there were such conditions present as gave to the star a reddish hue, or that M. TROUVELOT sees objects red where other observers do not.

I have been thus particular about details, because we now read published statements that are somewhat different. It is mentioned that he saw a decidedly red star "a little to the north and a little to the west of the *Sun*." He, moreover, is reported to have stated (*Nature*, page 546) that on September 5th and 7th, he examined the part of the sky where the *Sun* was then situate, with a telescope of the same aperture that he used in observing the eclipse, and with the eye-piece then employed, he recognized the two white stars which he had noted as 41 and ε *Arietis*, but the red star was not found, even though he swept to a much greater distance than any probable error of his observation would allow. On this circumstance he remarks:—

"As much as the absence of a red star as brilliant as that one I observed during the eclipse seemed naturally to lead me to suppose that the star in question was not other than an intra-mercurial planet, nevertheless, as the most necessary elements—such as the position, and a disk, or a sensible phase—failed my observation, I believe it is my duty to hold my opinion in reserve, and for the present suspend my conclusions upon the possible nature of this star."

With regard to the reference to the stars 41 *Arietis* and ε *Artetis*, respectively of the 4th and $4\frac{1}{2}$ magnitudes, it need only be remarked that they were not in or near the region of the reported red star. The former star was $10\frac{1}{4}^\circ$ north of the *Sun* and $2\frac{1}{2}^\circ$ to the east; the latter star was $4\frac{1}{3}^\circ$ north $\frac{1}{2}^\circ$ east of the *Sun*. They may be thrown out of the case, except as indicating that he saw them, probably with the naked eye, as he could hardly be looking in that locality for an intra-mercurial planet. Two or three stars of this constellation, but of the 5th and 6th magnitudes, lie from $1\frac{1}{2}$ to 3° to the north and west of δ *Arietis*, but they do not appear to have been seen.

We are therefore reduced to the consideration of δ *Arietis* as being the star which M. TROUVELOT saw. At our meeting he named the estimated distance of the observed star from the *Sun*, and this estimated distance almost exactly tallies with the position of δ *Arietis*; and his observing 3° west and 3° north is represented by $2\frac{3}{4}^\circ$ west and $2\frac{3}{4}^\circ$ north; the estimated magnitude agrees with the actual magnitude; and the absence of the disk and of phase, agree with the observer's statement that it was the star.

In my judgment, but one condition remains unsatisfied, namely, that it was a red star. And it seems to me not unlikely that there may have been atmospheric or possibly cosmic conditions in that vicinity which gave the star a reddish hue; or that he may have a tendency to see an object with a reddish tinge. The seeing 41 and ε *Arietis* as white stars might militate against this view. But in M. TROUVELOT's great atlas of astronomical drawings, and in his drawings of *Sun* spots, in the Cambridge Annals, we can not help noting that his red spot on *Jupiter* is very brilliantly red as compared with the appearance to most observers; and in some of the sun spots we find a reddish tint added to the blackness of the dark centres, the same reddish tint not being visible to other observers. It would be interesting for M. TROUVELOT to institute comparison with other observers in order to settle this color question.

THE NEW OBSERVATORY OF LA PLATA.

[Translated from the *Bulletin Astronomique* (French) by Miss NELLIE FIFIELD, Carleton College.—Ed.]

The last courier of Rio de la Plata brings the interesting news of the founding of a new observatory in South America, where there are, unfortunately, still so very few. The governor of the province of Buenos Ayres, M. DARDO ROCHA, who has already contributed so much to the recent progress accomplished in Argentine Confederation, has caused the decree of the foundation of a new city—La Plata—as the capital of the province. The city, already commenced at "la Ensenda de Baragan," on the bank of the river, will be provided with an observatory, the director of which is named M. BEUF, lieutenant of a very distinguished vessel of our navy, formerly director of the observatory of Toulon, and recently director of the Argentine naval school. The decree gives to M. BEUF an annual payment of 24,000f., and one sum of 100,000f. for the first construction, with the authorization of choosing his helps. He was permitted to use a certain number of excellent instruments constructed in France for the observation of the transit of *Venus*, at the expense of the government. The last courier brings, besides, the order of new instruments. The first very important work, as well in scientific point of view as in the needs of the administration of the country, to be undertaken, is the drawing of a map (or chart) of the province, of which we still have but very imperfect outlines. M. BEUF adopts, for this grand work, the only rapid, economical, and at the same time very exact process which the nature of this country permits. The immense extent and uniformity of the plains, or *pampas*, which compose the greater part of them in the present state, renders, in fact, impracticable the ordinary geodetical processes, because the very meager dimensions which would be possible to give to the triangles would have necessitated a considerable number of stations. It would result in a very great loss of time and a

great accumulation of errors in walking through a country so flat, where the absence of stone will render impossible the construction of a number of surveying signals. M. BEUF is, then, decided to profit with the extreme precision which we obtain to-day by the aid of our excellent portable instruments, and of the telegraph, in order to proceed to astronomical determinntion of fifty equally divided points over all the province, to which we shall re-attach by topographical process, as exact as possible, all the details of the surrounding country. If we have sufficient help we shall be able to carry abreast the two different operations, beginning with the most populated portion, and in a few years of toil shall obtain an excellent and very useful map of this grand province, where the population, railways, and the improvements of the soil, make, since five or twenty years, so rapid progress. It would be very desirable that this same process should be applied by the national government to the whole territory of the Argentine Confederation, each province bearing the expenses of the work which belongs to it. It is the only possible method of having, in a short time, and with least expense possible, a good map of the Argentine Confederation, and to make effective the measure of a grand arc of the meridian, which would be so useful in this part of the southern hemisphere to the study of the form of the globe. We could not congratulate the governor of the province of Buenos Ayres too much for the fruitful initiative which he has just taken in these scientific enterprises.

A Note on the Number of Stars in the Pleiades, by Professor E. S. HOLDEN.

The method proposed by M. CERASKI in Ast. Nach. 2581 to determine how many stars veritably belong to the group of the Pleiades, may be found in the Proc. A. A. A. S. for 1880, p. 7.

It is a perfectly rational method for solving, from a great number of cases, the general question, "How many (nominal) magnitudes of stars are associated together at the

same real distance from us?" But if it is applied to one cluster separately, the results may be found less certain than is desirable.

In the paper cited I have applied this method, so far as I had the data, to 167 clusters. It may be of interest to cite the result of this inquiry, which is that, so far as the data are sufficient, and on the assumption that the stars of each cluster are equally bright, per unit-area, the mean difference of (nominal) magnitudes is 3.8 *m* on Herschel's scale. So that the diameter of the largest star of each cluster is on the average 4.1 times the diameter of the smaller, if we admit the fundamental hypothesis.

The data on which these conclusions depend are given on pp. 10-15 of the memoir in question.

TRANSIT OF THE PONS' COMET OVER A BRIGTH STAR.

The passage or transit of a large comet over a large star is an event which very rarely occurs, and if, as in the present case, the comet be moving rapidly, the chances of any one observing it during the very brief interval of transit (in this case only two or three minutes) are extremely small. It is therefore a matter of some interest to preserve a carefully recorded instance of the kind, and by some few of your readers its importance will be recognized.

It has long been a mooted question by astronomers, whether a comet be of any more substantial materials than incandescent gas. Stars of the smallest magnitude are readily seen through their nebulosities, even when those nebulosities are hundreds of thousands of miles in diameter, but may there not be solid cores (to some comets at least) which would totally eclipse a star if they should be centrally superposed, even on a first magnitude star? This phenomenon has never yet been observed; but as it may arise from the minuteness of such solid or liquid cores, such negative testimony cannot decide the question.

Early in the evening of the 24th inst. I found Pons' comet

close to s star in *Cygnus* of the seventh magnitude, and from its relative position could see, at a glance, that a transit was inevitable. As I had been for three months watching this very comet for such an opportunity, I hurried my preparations, putting on a power of 100 and getting an assistant to mark time. The following are the results: Longitude of telescope being $5^h\ 26^m\ 28^s$ west of Greenwich; the star being of the seventh magnitude is not noted in ARGELANDER'S "Uranometria Nova," and is far outside of BESSEL'S zones; its right ascension, however, is $20^h\ 50^m$ and declination north 33°, or nearly so. Star began to fade at $6^h\ 31^m\ 42^s$ local time; star began to brighten at $6^h\ 35^m\ 22^s$; interval, $3^m\ 40^s$; middle time of transit, $6^h\ 33^m\ 32^s$; longitude west of Greenwich, $5^h\ 26^m\ 28^s$; or (by a singular coincidence) at 12^h, Greenwich mean midnight.

I am very sensible that it would be unsafe to state, in positive terms, that the star and the centre of the nucleus coincided; but, ta all appearances, the central line of passage, was through the star; yet I found it impossible to see the stellar centre of the comet in contact with the star on either side, and there was an interval corresponding with the waning of the star's light, when the nucleus was invisible. The star is an orange-tinted star, about 30^m south following ε *Cygni*, and faded by estimation half a magnitude.

If Pons comet, then, have a solid or liquid core, it cannot well be over two hundred miles in diameter, while the inference is, that it is, like many other comets, a gaseous body throughout, although to-night (December 27th), it shows a well-defined planetary disc, which, I must think, would obliterate an ordinary star. The tail (about 2° long) however, is diaphanous to stars down to the 13th and 14th magnitudes, even up to the circular nebulosity which surrounds the head.

The comet is now plainly visible to the naked eye; but only conspicuous in a good telescope; yet it is brightening fast, and *may* establish its claims to be ranked among the great comets of the century.—*Beta, in Times-Union* (Ill).

EDITORIAL NOTES.

Interesting notes and drawings of the Pons-Brooks' comet, by W. C. WINLOCK, Naval Observatory, Washington, D. C. have been received. They will appear in our next issue.

A cut and full description of the new Boswell observatory of Doane college, Crete, Nebraska, came too late for this month. This important scientific work, which has grown so rapidly under the direction of Professor G. D. SWEZEY will receive early attention.

Some of our readers have been much interested in the computation of the orbits of comets. Professor HOWE, having this in mind, in preparing the leader of this number, has given enough to guide any one in its computation having only a limited acquaintance with the higher mathematics. He purposes to continue work on the orbit of this great comet to make it as accurate as possible, and hence, needs all the observations of it that he can get. Any astronomer who will give him such aid will materially assist in a worthy object.

The seventh magnitude star on nearly the same parallel with *Beta Capricorni*, and preceding it by fourteen seconds in time, has attracted considerable attention during the last few months. In November last Mr. BARNARD of Nashville, was preparing to observe the occultation of *Beta Capricorni*, and happened to see the eclipse of this little star just before it. First about nine-tenths of its light disappeared, and for the space of one second there remained in its place a minute point of light estimated a tenth magnitude. This also instantly disappeared. Mr. BARNARD at once accounted for the strange phenomenon on the supposition that the star was a very unequal double, but he was unable to separate it with his six-inch equatorial. Mr. SAWYER of Cambridgeport, Mass., with a 4.37 inches Clacey equatorial observed the same phenomenon, and at the time attributed it to some irregularity in the *Moon's* surface; but since, says Mr. BARNARD'S explanation may prove to be the true one. Professor D. P. TODD, Amherst, Mass., also observed the same occultation, and says, that the little star disappeared very sharply at $8^h\ 16^m\ 2.^s5$; but about $1.^s5$ later a winged blur of light appeared at the same spot on the *Moon's* limb, and was visible for two or three tenths of a second, and of about half the brightness of the star itself. Professor TODD thinks that the theory of duplicity of the star will not account for all the phenomena observed, though, if found to be double, they may be in part so explained. Shortly after occultation, Mr. BURNHAM of Chicago, was unable to separate the star with the 18½-inch Dearborn refractor, and

a like attempt by Professor SWIFT of Rochester, N. Y., with the Warner 16-inch was unsuccessful. At the time of the last two observations the star was unfavorably situated for delicate work. The star is coming to place very soon however, so that its duplicity may be determined.

AN AURORAL GLOW ON THE MOON.

Last fall I was led to inspect the *Moon* with more than usual care. On November 4, 1883, I saw on the dark part of the *Moon* a misty light different from that to be ascribed to the feeble illumination due to light reflected from the *Earth*. This appearance was seen repeatedly by myself and others in November and December. The weather in January and February was not favorable to observations. But on March 29th last and 30th, the phenomenon was distinctly seen by myself and others. One who had seen it last fall, on looking at it on the 29th, remarked at once that it appeared on a different part of the disc, and, on the 30th, he noticed that the light had narrowed down.

This accumulation of light shifts its place upon the disc; but generally is seen brightest along the dark limb of the *Moon*. The appearance is that of the light of the *Aurora Borealis* on the *Earth*, as it might show to one looking at it from the *Moon*. I suggest this explination, therefore: that it is a light of the same nature as the *Aurora Borealis*, and produced by the same cause. So far as my observations go, this appearance is to be seen before the first quarter, and after the 3d quarter. At the time of quadrature, I have seen a line of light along the dark limb. I have been unable to see anything of it while the *Moon* is gibbous.

My telescope is a three-feet achromatic, two and one-fourth inches aperture, with a magnifying power of about sixty diameters. The eye-piece is negative. It is likely such diffused light is seen better with a low power.

JOHN HAYWOOD.

SMALL STAR PRECEDING BETA CAPRICORNI.

I am very glad to see (MESSENGER No. 23) that Professor TODD of Lawrence observatory, Amherst, Mass., also witnessed the phenomenon exhibited at the occultation of this small star on Nov. 6, 1883. If I had felt the slightest doubt concerning the character of this object, the remarks of Mr. SAWYER and Professor TODD would have confirmed my suspicions of duplicity. Before the remaining point of light had disappeared the explanation of the phenomena flashed upon me. I will again state that what I saw was simply an instantaneous diminution of the light of the star to a tiny point, and then the instant disappeaarnce of this; to me there was no total disappearance and reappearance of light.

It will be strange if no such phenomenon was observed at former occultations of the star. May I ask that the records of our observatories be looked over for similar notes on former occultations which must have been frequent since the star lies near the *Moon's* path? I had never seen the star eclipsed previous to Nov. 6, 1883.

E. E. BARNARD.

The royal road to success in the mastery of many things new and difficult in science is by calm and patient work, and by thorough and courteous discussion. Principles are always seen, most quickly and clearly, in such an atmosphere.

The discussion of the question of the true unit of time by English astronomers, for the last few months, seems latterly to have assumed the following form: Is mean solar time measured by the *Sun's* mean motion in longitude, or by its mean motion in hour-angle? If this statement fully and fairly represents Professor STONE'S side of it, which it is not easy to understand from the meager reports of the discussion before us, the question does not seem to be a difficult one. In studying it, however, it should be borne in mind that astronomers generally obtain mean solar time from local sidereal time. In making the change from the latter to the former, the mean longitude of the *Sun* at the time of change must be known. An error in this element will produce a corresponding one in the resulting mean solar time; but this error, as commonly thought of, is a well known constant, in regard to which LEVERRIER and HANSEN closely agree. To determine the amount of it, the reader is referred to any standard work in theoretical astronomy which discusses the fictitious year, the *Sun's* mean motion, and the length of the year, the epoch of the *Sun's* mean longitude, and the beginning of the fictitious year.

In a paper by Professor NEWCOMB, recently read before the Royal Astronomical Society, on Mr. STONE'S theory of the mean solar day, two points are especially noteworthy:—

1. Concerning the use of a *variable* unit of time in practical astronomy.

2. When this supposed change in the mean time unit began.

Following this paper, Professor STONE is reported to say (*Astronomical Register*, No. 256) that he had before stated that the change of time was due to the alterations of the equation of condition connecting the sidereal times and the mean solar times. Just what change he means to make in the equation of condition does not appear in the brief account.

On the second point he says: "It is evident that the change of time begins at the instant when the changes in connection between the sidereal times and mean times were made."

Professor STONE's way of testing the accuracy of his theory was by "a comparison between the observations made at the meridian of Greenwich with HANSEN's lunar tables, without any allowance for the errors of tabular mean time since 1864, and with the tabular places corrected for such errors in accordance with his theory." He says the comparison which extends over a complete revolution of the *Moon's* nodes afforded the most positive evidence of the correctness of his views.

One thing is certainly true; that Professor STONE is right or wrong in accounting as he does for the increase of errors in HANSEN's tables, and American astronomers will be interested in that question.

We have before called attention to the fact that the ROWLAND gratings are hereafter to be manufactured by Mr. JNO. A. BRASHEAR, Pittsburgh, Pa., and of the undoubted superior quality of the work done by the ROWLAND dividing engine. It now seems equally certain that the mechanical part of this delicate ruling process is to be skillfully managed; for the ability and experience of Mr. BRASHEAR is already favorably and generally known.

These gratings claim attention for three points of excellence:

1. They are much brighter than ordinary ones, in the higher orders of spectra, most of the light being thrown on one side for this purpose.

2. Their definition is surprisingly good.

3. Though not entirely free from ghosts, they are reasonably so only faint ones generally appearing.

From recent correspondence with Mr. E. F. SAWYER, Cambridgeport, Mass., respecting his observation of the minimum of *Algol*, reported last month, in connection with others, it ought to be said that his observation of November 28 was not given in exact time. It was stated that it occurred *about* 7 p. m. Mr. SAWYER observed the star in faint light, and near its minimum, and he intended to report it only as a rough approximation. On Dec. 21, at $6^h\ 40^m$ he observed it again, at minimum, which accords well with Mr. IRISH's table in Feb. No. of the MESSENGER.

That a periodical devoted to the interests of meteorology should soon make its appearance in this country, is only what observing scientists would naturally expect. There is need of it, and the attempt will doubtless have liberal support. Professor M. W. HARRINGTON, director of the Detroit observatory, Ann Arbor, Mich., who is a professional teacher of meteorology, takes charge of the editorial work, and W. H. BURR & Co. of Detroit are the publishers. It is to be known as the *American Meteorological Journal*, issued monthly, 24 to 32 octavo pages, subscription price being $3.00 a year.

THE WARNER PRIZES.

In printing the list of prizes bestowed by Mr. WARNER for discovery of comets several errors were made. To correct these, we gladly give place to the following from Professor SWIFT, under date of April 5:—

"I notice in the April number of the SIDEREAL MESSENGER several errors in regard to the successful competitors for the WARNER comet prizes. The following is the correct statement:—

May 1, 1881, Swift	$ 200
July 13, 1881, Schaeberle	200
Sept. 17, 1881, Barnard	200
Nov. 16, 1881, Swift	200
Sept. 10, 1882, Barnard	200
Sept. 1, 1883, Brooks' comet 1812	200

In addition to the above, which were regular, the following special prizes were awarded, viz.:—

For the periodic comet of short period, Oct. 10, 1880, Swift	$ 500
Feb. 23, 1883, comet Brooks-Swift, to Brooks	250
Total	$1,950

Mr. WARNER wishes it understood that in no case will he deviate from the conditions governing the regular prizes, as it would establish a dangerous precedent, and open a door which might in the future be troublesome to shut.

The first *special* prize was given because the comet was a periodic of the very short period of 5.5 years, and the second, because the discovery was made about the time the prize paper was completed, though before its publication.

The following are the elements of the new comet Ross, furnished to A. N. No. 2582 by R. L. F. ELLERY, of the observatory at Melbourne, Australia:

ELEMENTS.

$$T = 1883 \text{ Dec. } 25,\ 7838 \text{ Melbourne M. T.}$$
$$I = 125^\circ\ 15'\ 55''$$
$$\Omega = 265\ \ 12\ \ 15$$
$$i = 64\ \ 53\ \ 16$$
$$\log q = 9.502384.$$

Motion retrograde.

$$(C-O)\ d\alpha \cos\beta = +1''.6;\ d\beta = 24''.0$$

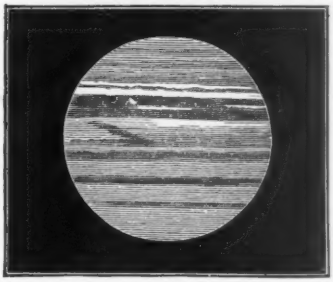
DARK TRANSITS OF JUPITER'S SATELLITES.

At the meeting of the California Academy of Sciences held on Monday evening, March 3, 1884, Professor DAVIDSON, the president, called attention to the observation of the black transits of the third and fourth satellites of *Jupiter* made by Messrs. BURCKHALTER and HILL and himself.

The first observation was upon the transit of the third satellite and its shadow over the disc of the planet on the 15th of January, at $9^h\ 1^m$ local time, by Professor DAVIDSON. It is illustrated in Fig. 1, wherein the small, dark disc is the shadow of the satellite, with the partially dark image of the satellite itself three or four diameters to the right. The figure gives the appearance of the planet, etc., in the inverting telescope.

When it was examined with powers of 120 to 150 diameters, the image of the satellite itself showed nearly as dark as the shadow, but not quite so large. After making the first drawing the atmosphere was steady enough to admit using 255 diameters. This was twelve minutes later, and then the satellite was seen as a circle with a segment of two-thirds the disc bright white and the other segment of one-third the disc dark or black. Upon again testing with

Fig. 1,



Jan. 15, *1884—Jupiter at 17h 11m G. M. T.*

the 120 power the same effect was revealed. The two were moving along, and upon the dark-brown red belt which has been persistent on *Jupiter* for some time, and yet they were very markedly black. The shadow was like a drop of ink. The satellite preceded the shadow. The observations were made with the 6.4-inch equatorial.

Professor DAVIDSON then read two short memoranda furnished by Messrs. HILL and BURCKHALTER upon their observations of the black transit of the fourth satellite on the 24th of February. The observation of Mr. C. B. HILL was made at the Davidson observatory, and that of Mr. C. BURCKHALTER at his observatory in Oakland, and therefore they are independent observations of the same phenomenon.

Mr. HILL reports: "On turning the equatorial on *Jupiter* about eleven and one-half hours I was surprised to see what was apparently the jet black shadow of one of the satellites. On looking it up in the

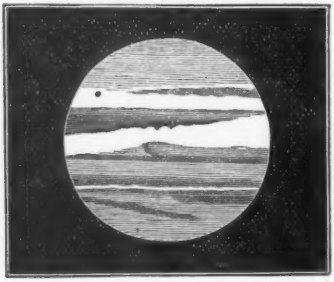
Ephemeris to see what satellite it could belong to, I found that the only phenomenon in progress was the transit of IV, the shadow of which should not come on until $15^h\ 43^m$, or four hours later, so that this was evidently a "black transit" occurrence.

1. Internal contact appeared to take place, $12^h\ 13^m$.
2. First white excrescence visible, $12^h\ 16.7^m$.
3. Satellite, probably tangent to limb, $12^h\ 21.8^m$.
4. Satellite. certainly clear of limb, $12^h\ 23.6^m$.
5. Satellite, one diameter clear, $12^h\ 30^m$ to $12^h\ 31^m$.

Hence, the egress apparently took place at $15^h\ 23.5^m$, Washington M. T., the Almanac time being $15^h\ 23^m$."

Mr. HILL has furnished the drawing for figure 2 to illustrate his bservation. It is a reproduction of the original in the note-book.

Fig. 2.



Jan. 24, 1884—Jupiter at 19h 54m G. M. T.

Mr. BURCKHALTER writes: "Last night I observed the transit of *Jupiter's* fourth satellite; the first contact was about two minutes later than the Almanac time, and the satellite was about eight minutes getting completely on the planet's disc. The air was very steady and definition good. The satellite entered the white portion just south of the great, dark-red belt. I observed the satellite for about five minutes after the internal contact, and saw nothing unusual, but on the contrary, could only see the bright satellite on the white belt with difficulty. At the Almanac time of II occultation disappearance ($8^h\ 52^m$ L. M. T.), Mr. W. H. LOWDEN took the instrument to observe the phenomenon, and he at once announced that there was a shadow of a satellite on the planet. Thinking he must be mistaken, I again looked and found, as he had said, a black spot 'as black as a drop of ink,' and I then noticed that this spot occupied about the position of the satellite then in transit. I then thought I must have made and

error, but upon referring to the Ephemeris, I found that no shadow should be on at that time, and that consequently it must be the fourth satellite projected on the disk as a black spot instead of the usual bead of light. This phenomenon so occupied our attention that the occultation disappearance was allowed to pass unnoticed. Thereafter we watched the spot, at intervals for nearly an hour, during which time it remained absolutely black."

It will be noticed that Mr. BURCKHALTER observed the satellite enter as a white disc on the body of the planet, and that it was subsequently seen black. He observed with a ten and a half-inch reflector, but does not report the magnifying power employed, and has furnished no drawings.

Professor DAVIDSON then referred to the earlier notices of these or similar phenomena. It was first reported by CASSINI in 1665, and afterwards more fully described by MARALDI, in 1707.

It was not again mentioned until 1796, perhaps from inattention to the subject; but more recently the grest telescopes have revealed these peculiarities. SOUTH saw two satellites on the planet, but of a chocolate color. BOND, on the 28th of January, 1848, observed the transits of I and II, whilst III itself was seen as a black spot between the two shadows, and not to be distinguished from them except by the place it occupied; it was smaller than its shadow in the proportion of 3 to 5, not duskish, simply, but quite black, like the shadow."

Again, on the 18th of May, 1848, BOND saw the III satellite enter the disc very bright; twenty minutes later it was hardly perceptible; a little after it was a dark spot; then for two and a half hours it was perfectly black and nearly round.

The transit of IV on March 25th, 1873, was remarkable for its absolute blackness, and was seen by many observers in England.

Several dark transits of I were recorded in England in 1880, and it is quite likely that the literature upon the subject of *Jupiter* may reveal other notices.

Several solutions of this curious problem have been offered, and were mentioned by the speaker, but none have been satisfactory.

—*From Sci. Press.*

Subscriptions and orders for the MESSENGER not previously acknowledged, and nearly all received during the month of April, were as follows:—

E. F. Sawyer, Cambridgeport, Mass.; Prof. C. H. McLeod, McGill College, Montreal, Canada; James B. Heiss, Monkton, Md.; J. Addison Campbell, No. 7, E. Penn. street, Germantown, Pa.; Rev. O. C. Clark, Friend, Nebraska; Professor John Haywood, Otterbein Uni-

versity, Westerville, O. Wm. H. Numsen (special order), Baltimore, Md.; L'Astronomie de Paris, Paris, ordered by W. F. Christern, New York City; Professor James Edward Oliver, Cornell University, Ithaca, N. Y.; Dr. T. D. Simonton, St. Paul, Minn.; Dr. C. H. F. Peters, Litchfield Observatory, Hamilton College, Clinton, N. Y. Mechanics' Institute, San Francisco, Cal.; James R. Baxter, Bloomfield, Indiana.

American astronomers can but be surprised at some things said recently in *Science* (Cambridge) in regard to the discussion on the change of the unit of time. This, for instance:—

Unless, then, this matter (question of the unit of time) admits of speedy and permanent decision, one way or the other, with the entire agreement of all parties to the controversy, astronomy would appear to run the serious risk of forfeiting her claim to a place among the exact sciences.

Is this the way our worthy and able contemporary thinks of astronomy, the oldest and the grandest science in the whole circle of exact learning?

If an eminent attorney should make a mistake in applying a fundamental principle of law to a case in hand, for example, would the next issue of the *Law Review* be expected to say that the whole system of American jurisprudence now appears to run the serious risk of forfeiting its place in our national polity? And this, also:—

The controvery on the unit of time is regrettable, but foreign astronomers are abundantly competent to conduct the discussion, as they have done heretofore, without additions to the literature of the subject on the part of any one here.

Comment is unnecessary.

Attention is called to Professor W. A. Rogers' advertisement of *Standards of Length*. Colleges and Scientific schools in this country can now be supplied from this source at a very moderate cost, with as accurate scientific standards as can be found anywhere.

Mr. Tydeman 835 Linden St., Camden, N. J., has a 4-inch, a 7-inch and a 12-inch diameter telescope, and a number of lenses and eyepieces for sale.

In the near future we hope to give our readers some account of Dr. C. H. F. Peters' late European trip.

On page 94, line 14 from bottom, of Messenger No. 23, read appearance for disappearance.

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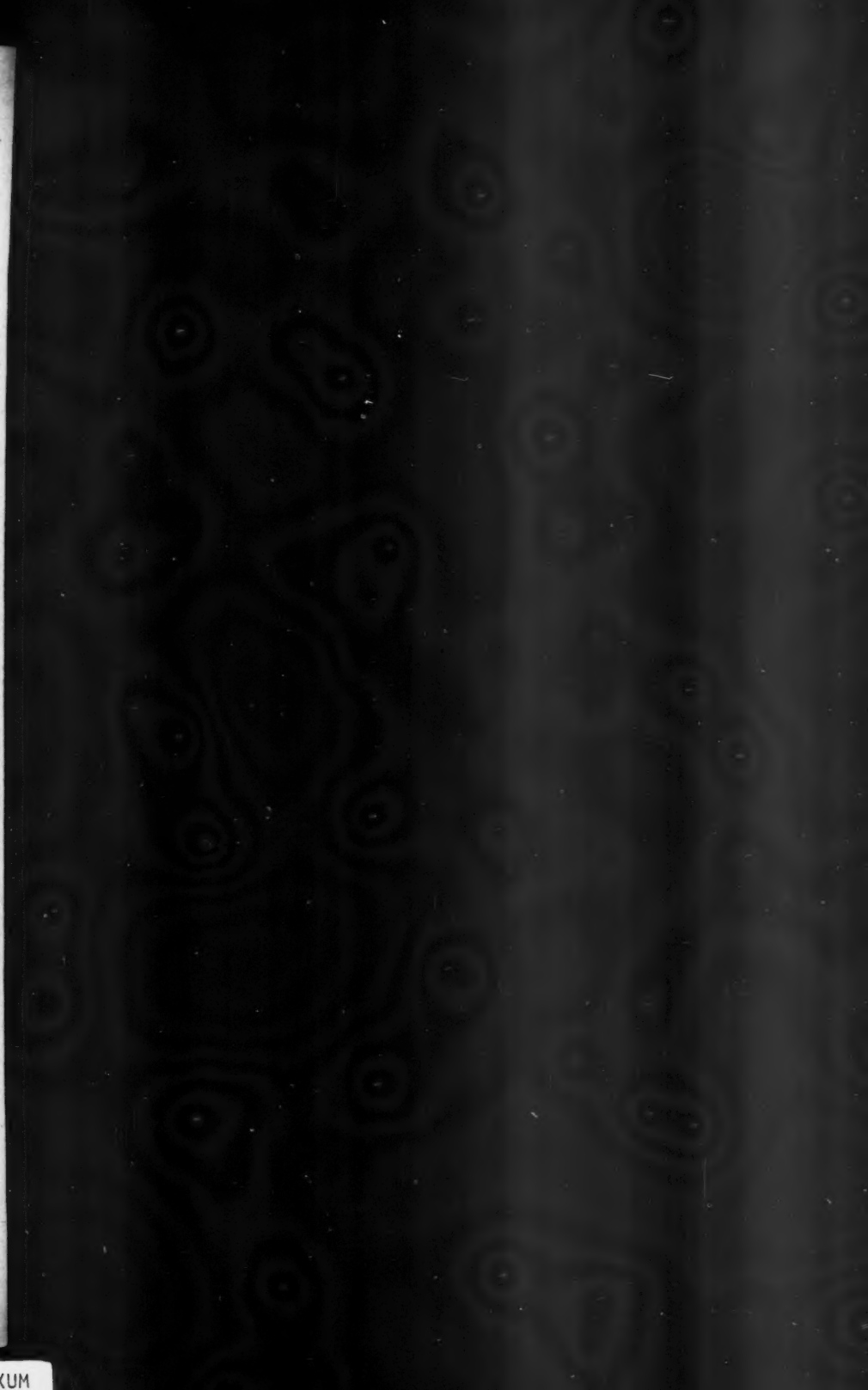
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